WINTER2008-2009

OKLAHOMACLIMATE

LIFE ON THE ROAD

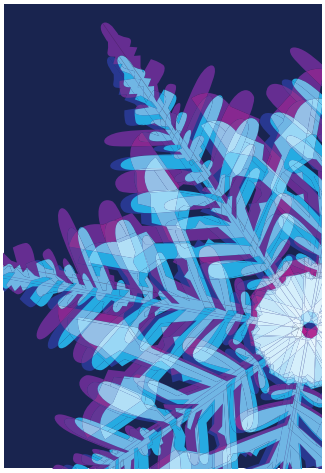
Glimpse into the life of a Mesonet technician.

DEEP FREEZE!

Oklahoma's devasting freeze of December 1983.

Also Inside

- Winter 2008-2009 Summary
- Classroom Excercises
- Agweather Watch



Oklahoma Climate
Winter 2008-2009

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MESSAGE FROM THE EDITOR

Gary McManus

I hate cold weather, and so do a lot of folks I know. There's a reason so many people flock to southern California, and the chance to ride a massive earthquake isn't one of them. It's not that I dislike winter, just the weather that goes with it! The strange thing is I used to love the season when I was growing up in Buffalo (Oklahoma, not New York...I didn't love winter THAT much). I suppose that's part of growing up, though. Sledding would just make my back ache now. The winters of my youth seem much colder than those of today, and since climate data show our winters have warmed over the last 20 years or so, it's probably not just something I imagined. Our historical perspective for this issue revisits one of the coldest months on record in Oklahoma – the second coldest of any month since 1940, to be exact – December 1983. Despite my fondness for winter at that stage of my life, I can't recall too many fond memories from that event. Read our take and see if you can remember anything good about the Oklahoma Deep Freeze of December 1983.

Speaking of our changing winters, remember when snow used to fall from the sky instead of sleet or freezing rain? Well, our first feature article looks at a climatology of heavy snows in Oklahoma by Mike Branick of the National Weather Service office in Norman. Did you think March was the prime month to get big snows? Well, you're right...sort of. Did you think most of those big snows occurred in southern Oklahoma? Sorry, now you're one for two. Our second feature article looks at one of the best programs the Oklahoma Mesonet has to offer; OK-Fire. The program's director, Dr. J.D. Carlson of Oklahoma State University, has written a great piece about OK-FIRE and how it performed during a large fire around Crescent, Oklahoma, in late January. Finally, in our third feature article, we learn about the life of a Mesonet Technician from our retiring Senior Electronics Technician, Ken Meyers. Reading his story has made me think I'm in the wrong line of work here at the Climate Survey! The Mesonet electronics technicians are the lifeblood of the Oklahoma Mesonet, so we are lessened as an organization when they leave us. We've been detailing the lives of distinguished scientists for the magazine's interview section, so we decided to switch gears for this issue and talk to some of our users instead. They all have such amazing stories about the Mesonet and how it has helped save lives and educate our state's children.

Snow...how do those fragile and unique flakes form? Our classroom exercise teaches students about these wondrous fractals of nature. In addition, be sure to read our regular features, including: an agricultural weather summary, the Urban Farmer, a weather safety article, and a climate summary of the fall months

I sincerely hope you enjoy this issue of "Oklahoma Climate." If you have any questions or comments, please feel free to contact me at gmcmanus@mesonet.org.

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OKLAHOMA CLIMATOLOGICAL SURVEY

The Oklahoma Deep Freeze of December 1983

Gary McManus – Associate State Climatologist

Think back, dear reader, to times of yore, when telephones had cords and video games consisted of two vertical lines and a dot. It was during these ancient times, the 1970s and 1980s, in which Oklahomans were able to experience actual winters, complete with snow and lengthy cold spells. It can certainly get cold from time-to-time during our current winters, of course. The warming that has taken place over the last 20-30 years, however, has left a generation of young Oklahomans with no inkling of what a truly cold winter can be like. There was a time when snow fell instead of freezing rain, and farmers spent their mornings busting ice from stock tanks before their first cup of hot java at the local cafe. So I ask you again, dear reader, to travel 25 years into Oklahoma's past, and relive the Oklahoma Deep Freeze of December 1983.

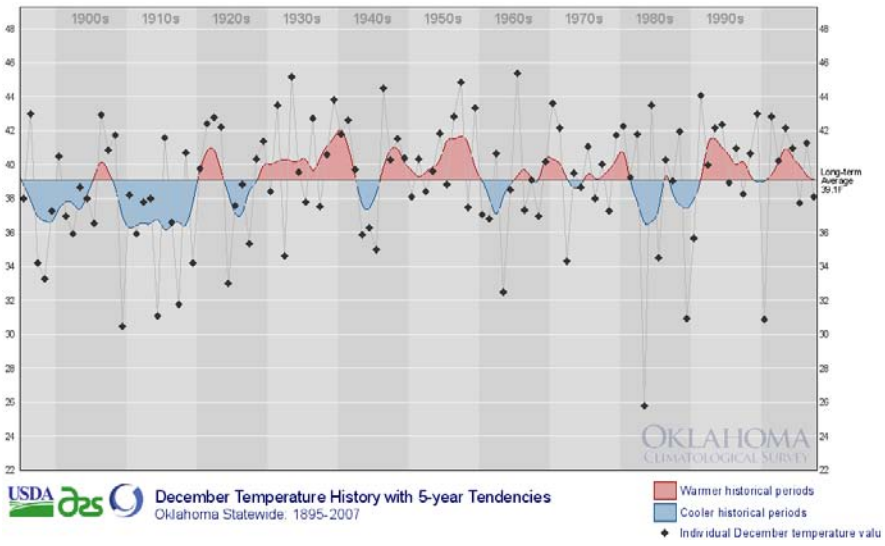


Figure 1: Statewide average December temperatures since 1895 for Oklahoma.

The first three weeks of December 1983 were actually quite pleasant as far as Decembers in Oklahoma go. High temperatures were near of above normal for most of that time with just a few intrusions of cold air to speak of. The state's first snowfall of any significance fell on the 13th but temperatures were too warm for the snow to last. Temperatures the next day rose into the 40s, obliterating the last traces of the frozen precipitation. A cold front late on the 15th combined with an upper-level low traveling from the west across Oklahoma to produce snowfall amounts of up to 8 inches along the Red River. Little did Oklahomans know that the cold front and snow were just the beginning of their wintery trouble.

Yet another cold front on the 17th brought a reinforcing blast of cold air to Oklahoma with more snow. The temperature at Guymon had dropped to 7 degrees by 5 p.m. and winds of up to 40 mph produced wind chills down to 20 degrees below zero. The 18th saw the cold air spread statewide with high temperatures struggling into double digits across most of the state. Strong winds dropped the wind chills down to 35 degrees below zero in some areas. As if the cold was not enough of a hardship for Oklahomans, Mother Nature gave them a good dose of freezing rain on the 20th as an exclamation point. The southern half of the state became a skating rink and travel was treacherous, resulting in many accidents.

Yet another surge of arctic air arrived on the 21st that sent temperatures plunging once again. Oklahoma City broke its record low temperature with a mark of 2 degrees below zero, and wind chills in some parts of the state were as low as 40 degrees below zero. The high temperature at the Great Salt Plains reservoir on the 22nd was 4 degrees below zero after a low temperature of 5 degrees below zero. Christmas Eve and Christmas Day saw Santa bring Oklahoma another blast of cold air and wind chills of 50 degrees below zero. Low temperatures across most of northern Oklahoma were below zero and high temperatures were in the low single digits. A warm up into the balmy 20s occurred for several days before a final-yet-brutal blast of cold air late on the 27th provided the state with its coldest temperature of the event; 17 degrees below zero was reported from the far western Panhandle town of Kenton on the 29th. A reading of 16 degrees below zero was recorded at Hulah Dam in Osage County the following day. Travel was discouraged on the 27th and 28th after nearly every road in the state was left covered with snow and ice.

New Year's Eve marked the end of the arctic transformation with temperatures rising above freezing for the first time since the first frigid blast on the 17th. Within days, temperatures were in the 60s across much of the state, putting the final nail in the coffin of the event. The month ended as the coldest December on record statewide with an average temperature of 25.8 degrees, 13.2 degrees below normal. Only four months have been colder in Oklahoma than December 1983, and all occurred in January: 1918, 1930, 1940, and 1979. The temperature in Oklahoma City was below freezing from 3 p.m. on the 18th to 10:45 a.m. on the 31st, the longest such stretch ever recorded. Nine daily records were also set in Oklahoma City – five for coldest high temperature and four for coldest low temperature.

The event left more than just a populace chilled to its bones, however. More than 20 deaths were blamed directly on the cold weather, mostly from traffic accidents, carbon monoxide poisoning, and exposure. Infrastructure also took a hit due to the arctic chill. Frozen water pipes left thousands without water for days, and when those pipes did thaw, hefty plumber bills ensued. Fire departments in Oklahoma City became emergency water distribution points for those with frozen pipes. And the misery was not confined to Oklahoma, of course. Most of the eastern half of the nation was gripped in the wintry weather's hold for a similar duration. Nationally, more than 500 deaths were attributed to the cold weather, as well as the destruction of infrastructure and crops. The Red River in Shreveport was reportedly clogged with the most ice since 1895, and damages in Texas alone were estimated at over $100 million.

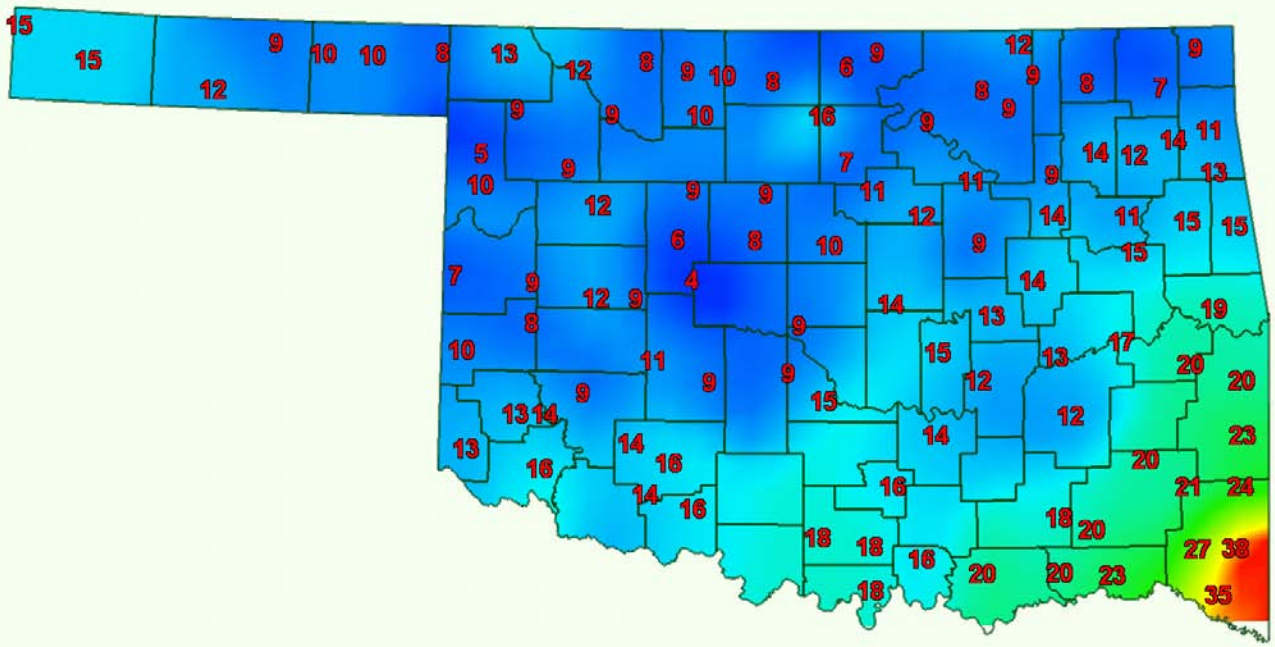


Figure 2: High temperatures on December 19, 1983.

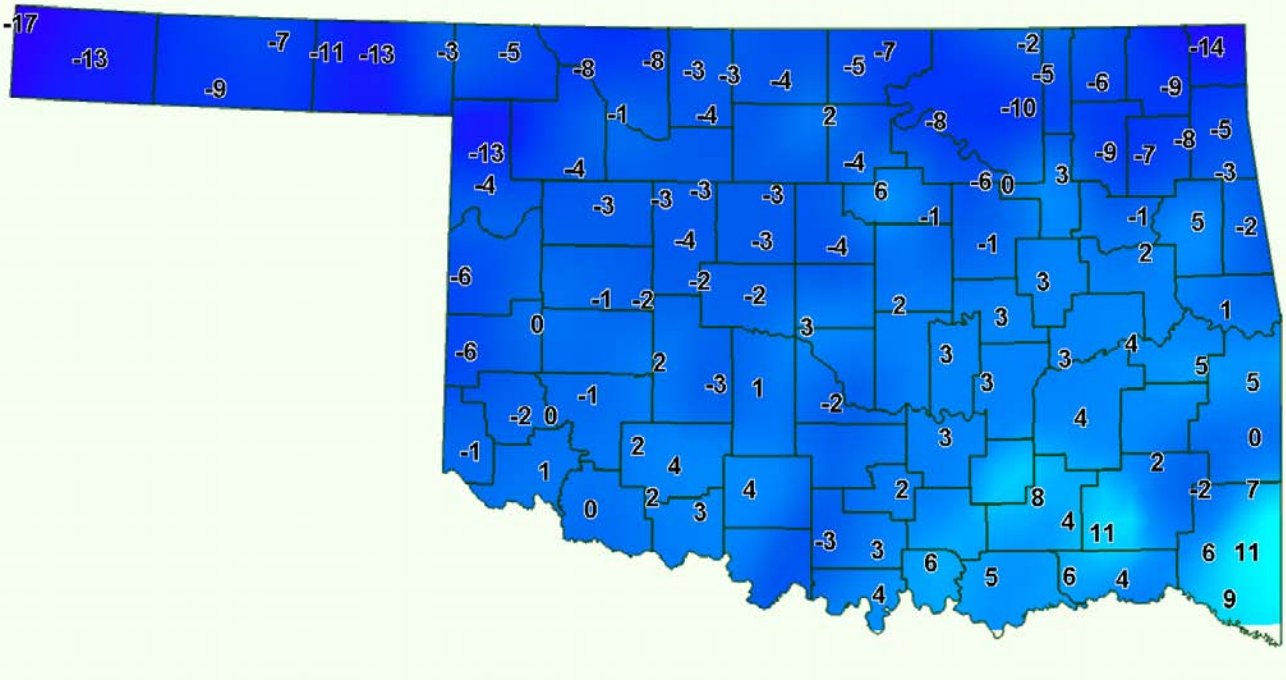


Figure 3: Low temperatures on December 29, 1983.

THERE'S SNOW PLACE LIKE HOME

Gary McManus | Associate State Climatologist

How many times have you heard this?

"Oklahoma's heaviest snows usually come in March."

How about this one?

"Southern Oklahoma gets more heavy snows because it's closer to the Gulf of Mexico."

Well, as with all weather lore, some are based on a little bit of truth while others are just faulty memories. Snow is certainly not a topic Oklahomans deal with as much as other types of inclement weather. Most of us can recite the Fujita chart by memory now, but snow is a bit more fleeting in our memory banks. This has become even more true since most of the snowstorms of our past appear to have morphed into sleet and ice storms. But let's take a look at what National Weather Service forecaster Mike Branick found buried under an avalanche of Oklahoma snowfall data. He looked at snowfall data from 1951-2001 and found 225 "heavy" snowfall events for the state, with "heavy" defined as 6 inches in 24 hours or two 24-hour reports of 4 inches or more.

Looking at his results, we can easily dispel one myth right off the bat; sleds are normally not a hot commodity in southern Oklahoma. Logic wins out on this one – southern Oklahoma does not receive the greatest number of heavy snows in Oklahoma. In fact, it receives snowfalls of 4 inches or greater once every 2-3 years or so, while northwestern Oklahoma can receive these types of snows several times a year. For heavier events, 8 inches or greater, the disparity grows even larger. Southern Oklahoma will receive a snowfall of 8 inches or greater once every 10-20 years while northwestern Oklahoma might get one every couple of years. As it turns out, the colder air in the northern parts of the state trumps the extra moisture available in the south. The combination of the two occurs more often up north.

If Oklahoma were to receive a heavy snow, when would it most likely occur? That one is a bit trickier. Despite their rarity, southern Oklahoma receives more of its heavy snowfalls in January, the coldest month of the year. As you head north, however, the peak for heavy snows spreads out. This is possibly due to the extended periods with sufficiently cold air available for snow formation. Along the I-44 corridor, the heavy snow frequency is greatest in January and February. For 8-inch or greater events only, however, the peak for the northeast is most definitely in March. As you look farther to the west and north, the frequency for heavy snows shifts to February then March. If you want to see a snow of 4 inches or greater in the western Panhandle, March is the month. If you want to see a snow of at least 8 inches, January or March will both prime bets.

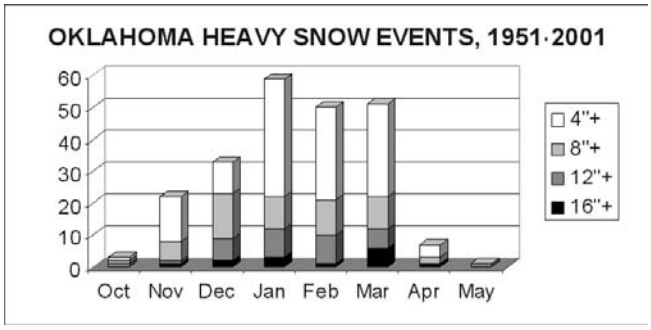


Figure 1. Total number of heavy snowfall events in Oklahoma by month.

Heaviest snowfall events in Oklahoma, 1951-2001

RANK	DATE(S)	MAX	LOCATION
1	21-22 February 1971	36	Buffalo
2	24-25 November 1992	22	Laverne
3	16 March, 1970	20	Bartlesville
	16-17 January 2001	20	Kenton
5	8-9 March 1994	19	Stillwater
	12-14 March 1999	19	Medford
7	4-5 March 1989	18	Kansas
	18-19 January 1990	18	Goodwell
	22-24 December 1997	18	Laverne
	18-19 March 1999	18	Kenton

Table 1. Heaviest snowfall events in Oklahoma, 1951-2001. Rankings are based on maximum storm totals (Max, inches). Location of the maximum reported storm total for each event is given.

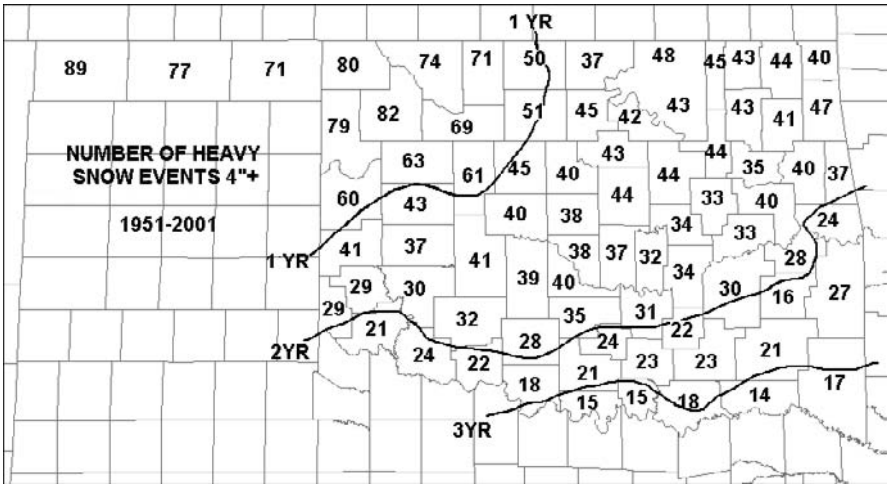


Figure 2. Number of four-inch or greater snow events by county, 1951-2001. Contours are frequencies, given as average turnaround times for a single event.

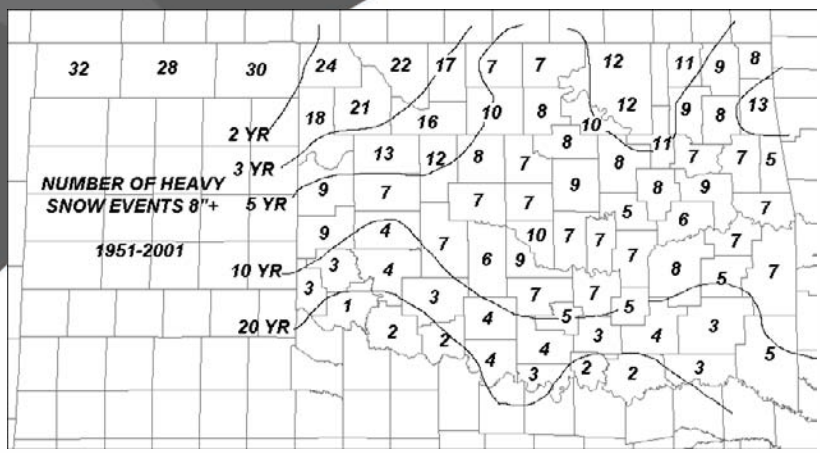


Figure 3. As in Fig. 3, except for eight-inch or greater events.

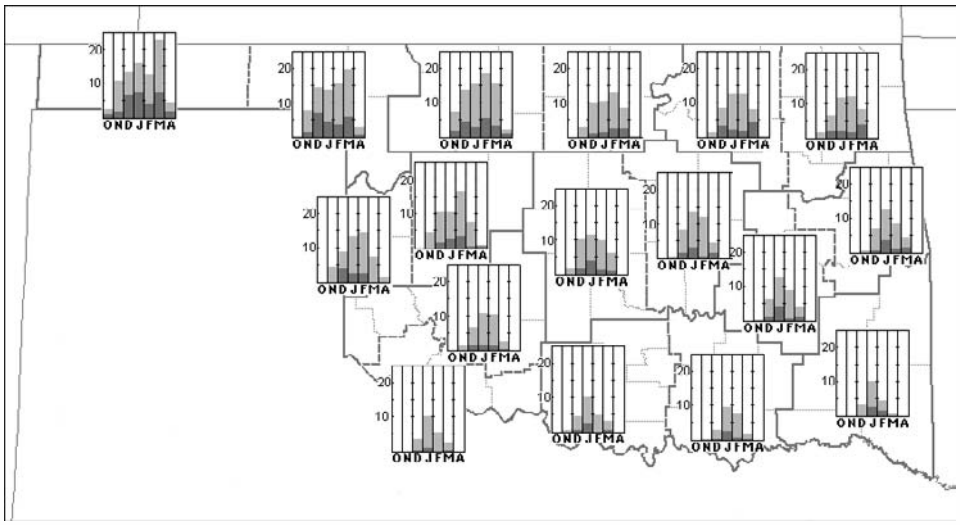


Figure 4. Monthly distribution of four-inch (light) and eight-inch (dark) snow events by region.

There are many factors needed to produce heavy snowfall. The chance meeting of adequate moisture and cold air vitally important to producing snow is often fleeting. But the climatology of heavy snows across Oklahoma has given us a clue of where to search for these types of events. While the state can see a heavy snow from October through early May, the place to be if you want to see a good pounding by the white stuff is the Oklahoma Panhandle, and you should be there in March. An interesting side-note is that the largest snow events, 16 inches or more, are clearly more frequent during March than any other month.

The information in this story is largely attributable to Mike Branick, Senior Forecaster for the National Weather Service forecast office in Norman, Oklahoma. His study on the subject is titled "Monthly and Geographic Distribution of Heavy Snow Events in Oklahoma, 1951-2001". The full report can be found at **http://www.srh.noaa.gov/oun/climate/heavysnow/study.php**.

IN THEIR OWN WORDS

THE VARIOUS PRODUCT USERS OF THE OKLAHOMA MESONET

By Phil Browder, Field Technician
Oklahoma Mesonet

For the last 15 years, the Oklahoma Climatological Survey (OCS) has joined forces with the Oklahoma Mesonet to provide the citizens of Oklahoma with the best surface observing network in the world. That in and of itself would be enough, but by taking a commitment to excellence a step further, OCS also provides several products using Mesonet data that serve to enrich and protect the lives of residents across our state. Here are four of the most popular products, each with a rich history of serving the state of Oklahoma. However, you don't have to take my word for it….

OK-FIRST: "It's astronomical."

That's how David Barnes, Director of Emergency Management for Oklahoma County, describes the impact OK-FIRST has had in the realm of public safety in Oklahoma: "[OK-FIRST] not only gives us good information and helps us give good info to the public, but it also adds a great deal of credibility to our programs".

Since 1996, OK-FIRST has been using training, data services and decision support as the backbone of a system designed to help save lives, resources, and money. The mission of OK-FIRST is simply to help Oklahoma's public safety officials make better decisions during weather-impacted situations.

Before becoming Emergency Manager of Oklahoma County, David spent 8 ½ years as an Emergency Manager in Edmond. It was there he was introduced to OK-FIRST training and quickly realized just how useful it could be. "Using the Mesonet, using OK-FIRST, has corporately improved our education and our professionalism", David says. "We now have greater tools available for use because of the re-certifications and the refreshers that we participate in, as well as the workshops where presentations are made. We are able to maintain those skills and fine-tune them on an ongoing basis, as opposed to getting a class one time and waiting four or five years". From improved storm spotting to aiding in the prosecution of criminal cases, David raves about OK-FIRST and the Mesonet, asserting the program "helps us [Emergency Managers] make better decisions" by strengthening relationships between public safety offices, meteorologists, and the academic community.

EARTHSTORM: "It's so cool to teach with weather!"

You need not talk with Lori Painter for very long before the subject turns to her kids. In this case, her "kids" are the 6th grade class at Monroe Elementary in Enid, and she accompanied a few of them to the National Weather Center in Norman this past February 21st to compete in the annual Mesonet Science Fair. Inside, a whole host of exhibits were on display, with exhibitors ranging in grade from kindergarten through high school senior. Despite the different ages, shapes and sizes, the competitors all shared an interest in the weather. That interest, according to Lori, wouldn't have been possible without EARTHSTORM—a series of workshops put on by OCS designed to help teachers use the Mesonet to bring the wonder of weather into their classrooms. "I can just hit a button and see the same thing in a half a second what used to take me 10 or 20 minutes to see", says Lori. "It is so powerful and so easy for my kids to use".

I CAN JUST HIT A BUTTON AND SEE THE SAME THING IN A HALF A SECOND WHAT **USED TO TAKE ME 10 OR 20 MINUTES TO SEE**

For Lori, who was one of the first teachers to attend the program when it began 16 years ago, EARTHSTORM represents more than just learning about the weather. In fact, she says the program "has absolutely changed the way I teach". Another teacher in attendance, Roberta Chance, echoes Lori's enthusiasm for the program: "It has given my kids in northwestern Oklahoma in a small school access to the very same technology that metro kids have". Roberta, who teaches 7th and 8th grades at Gage Public Schools in Gage, says EARTHSTORM has received a "wonderful" reception, and makes the weather "more and more accessible to our kids".

While the students flexed their knowledge on that clear, cool Oklahoma afternoon, teachers like Lori and Roberta sat back with proud smiles and watched as the seeds they had planted took root and blossomed. While both teachers knew few, if any, of their students would make a career out of the weather, Lori says the children who pass through their classes take with them an ability to think for themselves, and those are skills they will use for the rest of their lives. "No matter what they go into, they will be better doctors, lawyers, or anything", reasons Lori, "because they now have the skills to problem solve, and it was because of EARTHSTORM".

OK-FIRST/OK-FIRE:

"Three-quarters of my citizens know what OK-FIRST is."

Ask Tom Merrill, Fire Chief and Emergency Manager for the city of Cordell, why he began using OCS products and he will respond not with a reason, but with a date: October 9, 2001. That's the day an F-3 tornado tore through the east central side of Cordell, destroying 134 homes and damaging more than 300, along with more than 40 businesses. Despite giving residents of Cordell nearly 12 minutes of warning time, Tom says it quickly "became apparent to us our warning system was lacking". While surveying the damage afterwards, Tom was approached by Mike Foster, a representative from the National Weather Service. When Mike asked Tom if he had heard of OK-FIRST, Tom remembers he had "no clue". Shortly after his talk with Mike, Tom enrolled in his first OK-FIRST class, and has been "going strong ever since".

But OK-FIRST isn't the only product Tom puts to good use. He'll tell you being a fire chief of a small town in western Oklahoma demands all the help you can get your hands on, none being more important than OK-FIRE—an extension of OK-FIRST dedicated to providing fire fighters the training and tools they need to combat wildfires most effectively. "It has allowed us to pre-plan and pre-position fire units in anticipation of what we knew was coming", says Tom. "We watch OK-FIRE constantly throughout the day, keeping track of burning indices".

AGWEATHER:

"Very dynamic."

Tom's other passion, farming, leads him straight to the AgWeather website, a tool he calls, "one of the most underrated products [OCS] has". AgWeather, a cooperative project between Oklahoma State University, the University of Oklahoma, and OCS, brings together expertise in the areas of meteorology, climatology, agricultural production, and natural resource management. The goal is to provide Oklahoma farmers with the tools they need to grow the best crops they can, but Tom says AgWeather's impact is more far-reaching than that: "It's got a lot of economic value", Tom says, "not just to citizens, but also to businesses. They keep it interesting, and give us the products we want and not just the products they want to give us".

"We watch OK-FIRE constantly throught the day, keeping track of burning indecies"

WILDFIRE WEEKEND

Some Perspective on the Wildfires of January 31 and February 1

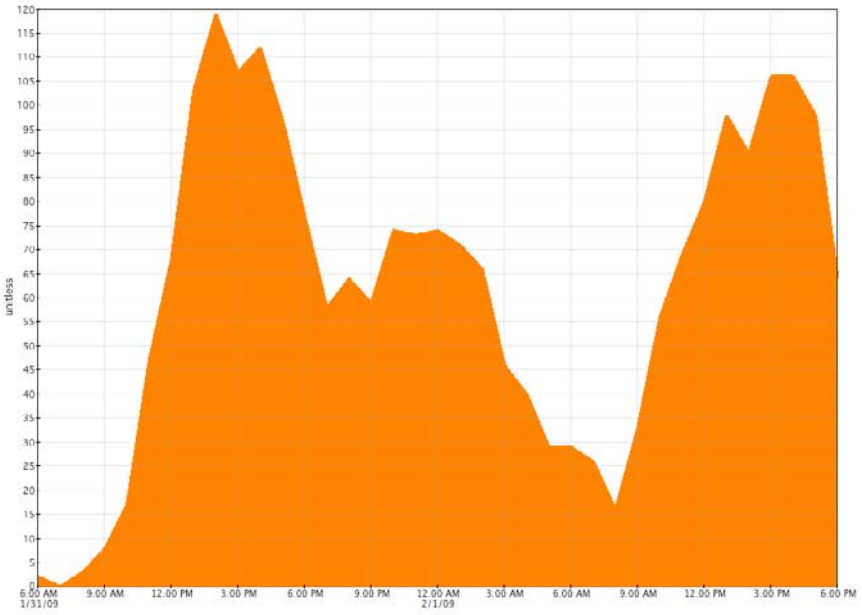


Figure 1. Burning index (BI) values at Marshall during the wildfire period of January 31 and February 1, 2009.

Dr. J. D. Carlson, Fire Meteorologist
Oklahoma State University

During the late afternoon of January 31, while driving around town in Stillwater, I noticed a huge smoke plume to the west-southwest, a plume which extended many miles to a position northeast of Perry. It turns out the smoke was the result of a large wildfire (grassy/brushy fuels) near Crescent, north of Guthrie. The fire erupted Saturday afternoon and burned at least 600 acres. A total of 26 fire crews helped combat the blaze. At one point that day the fire was estimated to be four miles long and four miles wide. The fire was extinguished Saturday evening, but flared up early Sunday afternoon with the high fire danger conditions. That fire burned even more acres and the total estimated area burned was 2000 acres.

Simultaneous to the Crescent fire on January 31 were even larger wildfires in northwest Oklahoma. One blaze near Selman in Harper County burned 10,000 acres, while another near Mooreland in Woodward County consumed another 5,000 acres. The smoke plumes from these fires were easily visible on radar that afternoon. These fires also reignited on Sunday afternoon.

What were the fire weather conditions like over this weekend that led to the outbreak of these wildfires? We'll concentrate on the Crescent fires in this analysis. However, before we delve into the weather conditions themselves, let's look at some output from the Oklahoma Fire Danger Model, whose output is available on our OK-FIRE wildland fire management web site (http://okfire.mesonet.org).

The "Burning Index" (BI) is one index calculated by the National Fire Danger Rating System (NFDRS) on which our Oklahoma model is based. It is proportional to the intensity of the fire (i.e., fire danger) – the greater the BI value, the greater the difficulty of suppressing the wildfire. Burning Index is a function of the weather conditions as well as the fuel type and amount. A BI of 40 is considered a moderate threshold for fire danger and a BI of 80, a high threshold. Figure 1 shows the BI values at Marshall (a nearby Oklahoma Mesonet site) from 6 a.m. January 31 to 6 p.m. February 1. Note that during both afternoons, BI values were well in excess of 80 – on Saturday they reached up to 120 and on Sunday, up to 106. Also impressive is the rapid rise in BI

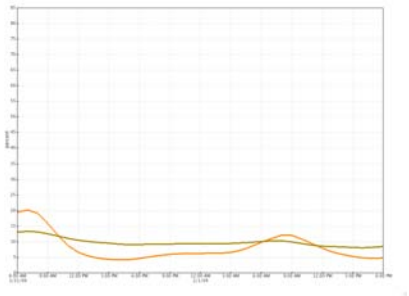


Figure 2. 1-hour (orange) and 10-hour (brown) dead fuel moisture at Marshall during the wildfire period of January 31 and February 1, 2009

from zero at 7 a.m. Saturday to 120 at 2 p.m. Corresponding to the BI peaks on Saturday and Sunday were high spread rates as calculated by the "Spread Component" (SC). Values as high as 180 feet/minute (60 yards/minute) were calculated on Saturday and as high as 140 feet/minute (47 yards/minute) on Sunday. Think of a football field and you'll get an idea of how fast these fires were moving. The high BI values (fire intensity) combined with the high SC rates (rate of spread) made these fires extremely difficult to control.

Another important indicator of fire danger (especially during this time of year) is dead fuel moisture (DFM). In particular, 1-hour and 10-hour dead fuels are of supreme interest. One-hour dead fuels represent the dead grasses and leaves which are prevalent during the winter season, while 10-hour fuels represent dead fuels with diameters on the order of one-half inch. Wildfires usually start with the ignition of 1-hour fuels, and 1-hour dead fuel moisture (the % water content in such fuels) is therefore of extreme importance. Both for 1- and 10-hour fuels, fuel moisture contents of less than 5% lead to extremely dangerous fire danger and behavior, and even in the 5-7% range, there are serious problems. Figure 2 shows the calculated 1- and 10-hour DFM at the Marshall site. Note that 1-h DFM (orange line) dropped as low as 4% during Saturday and almost reached 4% on Sunday.

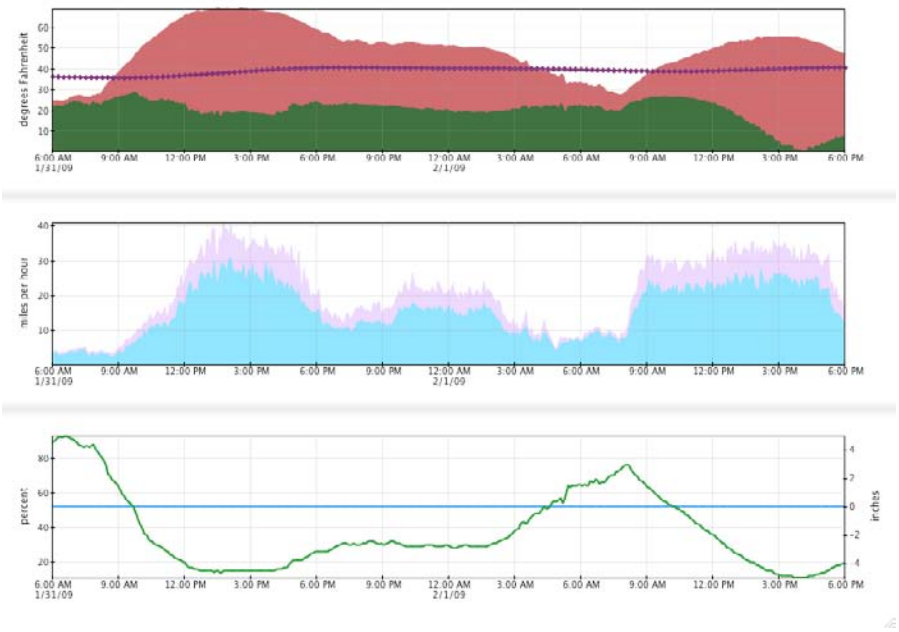


Figure 3. Meteogram of temperature, wind speeds and gusts, and relative humidity at Marshall during the wildfire episode period of January 31 and February 1, 2009.

Let's now look at the weather conditions responsible for these low fuel moisture contents and the high burning index and spread component values. Figure 3 presents a meteogram for Marshall consisting of three charts. The first chart shows temperature (F) in red; the second one shows sustained wind speeds (mph) at the 10-m level in blue and gusts in purple; and the third one shows relative humidity (%) in green. What happened "weather-wise" to go from virtually no fire danger in the morning to extreme fire danger in the early afternoon that Saturday?

Temperature (and solar radiation), relative humidity, and wind speed all play important roles in fire danger and behavior. Let's first look at the temperature. Note how the temperatures rise from the mid-20s around 7 a.m. to near 70 degrees around 2 p.m. That's a quick rise in temperature, which results in the 1-hour fuels quickly rising in temperature as well (the clear skies that afternoon amplified this as the fuels absorbed solar radiation and grew even warmer). With respect to wind speed, note how speeds are 5 mph or less in the early morning and quickly increase

to 30 mph in the early afternoon with wind gusts up to 40 mph. This is typical of a sunny convective afternoon where strong upper-level winds are mixed down to the surface. Finally, with respect to relative humidity (the most important fire weather variable), note how the high values in the early morning (around 90%) quickly fall to values of 15% for most of the afternoon. Lower values of relative humidity result in more evaporation of water from the dead fuels and thus lower dead fuel moisture. On the following afternoon (Sunday) relative humidity dropped to even lower values (11%) near 3 and 4 p.m.

We'll conclude by looking at some smoke plume pictures from the Crescent fire which I took that Saturday afternoon. The first photo (Figure 4) shows the boundary layer and, at this time, the turbulence that was present within it. The boundary is that layer above the surface (typically 3000 to 5000 feet during the afternoon) in which surface friction and other surface processes (e.g., surface heating) play a role. On Saturday there was both convective (temperature-based) and mechanical (wind-based) turbulence within this layer, with upward and downward motions. By the time the smoke plume had reached the position shown in Figure 4, most of the plume had risen to the top of the boundary layer. Note, however, how portions of the plume are being brought back down to the surface due to the convective and mechanical turbulence.

Figure 4. Convective and mechanical turbulence within the boundary layer as shown by the smoke patterns.

Figure 5. Existence of gravity waves as shown by the smoke plume patterns.

The final photo (Figure 5) shows us something else about the atmosphere. During days with clear skies (as this was), the region just above the boundary layer typically features either an inversion (temperature increasing with height) or more "stable" air than the air within the boundary layer. Such a layer features dramatically less turbulence and, in some cases, "gravity waves" can form. In Figure 5, which shows the furthermost extent of the Crescent smoke plume northeast of Perry, the bulk of the plume is now in the layer above the boundary layer. Notice how the turbulence is not only less, but how the smoke shows wavelike motions. These are tell-tale signs of gravity waves, waves like surface ocean waves but in this case in the atmosphere. They only occur under "stable" conditions as such was the case in this layer.

In summary, the wildfires during the weekend of January 31 and February 1 were made possible by the low relative humidity, relatively high temperatures, and strong winds during Saturday and Sunday afternoons. These conditions, along with the prevalent dead fuels (as evidenced in Figure 5), led to low 1-hour dead fuel moisture and high Burning Index and Spread Component values. During this fire season, to keep track of existing and future fire danger (using the 84-hour NAM forecast) within Oklahoma, go to the OK-FIRE web site (http://okfire.mesonet.org).

FALL 2008 SUMMARY

by Gary McManus

The season was dominated by cooler weather and, depending on your location, either abundantly wet or exceedingly dry conditions. The remnants of several tropical systems provided the moisture for a few select regions of the state. Hurricane Gustav struck first in early September in east central Oklahoma. Hurricane Ike and Tropical Storm Lowell visited the state soon thereafter, while Hurricane Norbert struck in October. The tropical well ran dry in November, however, and most of the state was 20-60 percent of normal precipitation for the month. The result was a soggy fall for the northwest one-third and a parched season for the remainder of the state. Averaged statewide, the precipitation total ranked as the 49th driest on record with a deficit of more than 2 inches. The influx of tropical moisture helped cool the statewide temperatures enough to rank as the 30th coolest autumn on record at about a degree less than normal.

SEPTEMBER DAILY HIGHLIGHTS

September 1-4: September's first day was pleasant, if a bit hot, with just a smattering of clouds across the state. Some of those clouds were associated with the remnants of Hurricane Gustav which had come ashore near New Orleans before moving towards eastern Oklahoma. At the same time, a cold front was approaching the state from the northwest. The cold front and Gustav both arrived on the second. Temperatures dropped into the 60s and 70s behind the front, and rain began to fall in eastern Oklahoma from Gustav. Light showers formed near the front in the west. What remained of Gustav continued to move along the Oklahoma-Arkansas border over the next couple of days. The front stalled in eastern Oklahoma on the third. Temperatures only rose into the 60s and 70s on that day, and Oklahoma City set a record for coolest maximum temperature with a high of 68 degrees. Rain continued overnight as Gustav pulled away to the northeast before skies cleared later in the afternoon. Rainfall totals from Gustav approached 5 inches in east central Oklahoma but tapered off rather quickly to the west. Rain totals from the frontal passage in the western two-thirds were generally between a tenth of an inch and an inch.

September 5-10: Heavy rains fell during these six days, largely in north central Oklahoma. A meandering frontal system in northern Oklahoma provided the focus for several rounds of storms, mostly overnight, which inundated that area with up to 9 inches of rainfall. Other areas of the state had scattered rainfall amounts of an inch or a bit more, but nothing as organized as in the north. The frontal system kept northern Oklahoma in the 60s and 70s while southern parts of the state were in the 80s and 90s. The storms were severe on the fifth; large hail was common with the storms in northwestern Oklahoma, including hail up to the size of tennis balls near Sayre and Reydon in Beckham County.

September 11-13: Remnants of Hurricane Ike from the Atlantic Ocean drenched eastern Oklahoma with tropical rainfall amounts, while remnants of pacific tropical storm Lowell did the same to western Oklahoma. Northwestern areas definitely got the wet end of the stick, however, due to Lowell's interaction with a frontal boundary. Ike's remnants dropped 2-3 inches of rain across the eastern one-third of the state while parts of the northwest received nearly 12 inches. Fairview suffered severe flooding as 11.8 inches of rainfall was recorded by the Mesonet site there. Temperatures remained in the 70s and 80s, both lows and highs throughout this period. The remnants of both tropical cyclones moved away from the state on the 13th and left tranquil weather in their wake.

September 14-21: As the tropical systems exited, high pressure at the surface moved in and brought the state a slow warm-up to near normal temperatures over the next eight days. There was no significant precipitation to speak of other than a few amounts around a half of an inch in far eastern Oklahoma. Lows were mostly in the 40s and 50s and highs in the 70s and 80s.

September 22-30: High pressure remained and the weather warmed over the next seven days to near-normal to above-normal territory. Highs were mainly in the 80s with a few 90s after lows in the 50s.

September 29-30: A cold front finally found the state and passed through on the 29th. Highs were in the 70s for the most part after the cold front with lows in the 40s and 50s.

OCTOBER DAILY HIGHLIGHTS

October 1-3: The month's first three days were pleasant with cool mornings and seasonable afternoons. There was little rain to speak of as lows dropped into the 40s and 50s each morning and highs rose into the 70s and 80s.

October 4-6: A warm front lifted north on the fourth as an upper-level storm system approached from the west. That provided enough moisture to fire off showers and storms that dropped up to two inches of rainfall in southeastern Oklahoma. The storm system caused winds to gust over 40 mph in western Oklahoma. Highs were above normal in the 80s and 90s. The month's high temperature reading of 93 degrees occurred at Tipton and Grandfield on the fourth. The days continued mild as the storm system approached. Showers and storms hit the state on the fifth and sixth, with the storms on the sixth exceeding severe limits at times. The severe reports were mostly of large hail in western Oklahoma. Hail to the size of half dollars was reported in Comanche County. Most of the state saw rain over this three-day period, with heaviest amounts reported in southern sections of Oklahoma.

October 7-10: A mostly dry four days followed the previous bouts of rainfall. Each successive day was warmer than the last with the aid of strong southerly winds that kicked up in lieu of an approaching upper-level storm. By the tenth, highs had risen into the mid-80s.

October 11-15: Moisture from the remnants of pacific hurricane Norbert streamed into western Oklahoma in the form of clouds on the 11th. A surface low in the Oklahoma Panhandle kept winds gusting from the south at over 30 mph. Highs were in the 70s and 80s. Rain developed in the

Oklahoma Panhandle as the remnants of Norbert interacted with a cold front. That front and associated storm system provided the focus for several rounds of showers through the 15th. In all, areas of the Panhandle received from 3-4 inches of rain while other parts of northwestern Oklahoma totaled 1-3 inches. The rest of the state had up to an inch. The cold front separated high temperatures in the 70s and 80s to the south and 50s in the north. The rainfall ended the afternoon of the 15th and cooler air settled in from the north.

October 16-21: The weather turned cold following the cold front's passage on the 15th. High pressure settled over the area and the weather became pleasant if not a bit windy. Winds gusted up to 40 mph on the 19th as a strong upper-level storm approached from the west. Highs were in the 70s and 80s for the most part, 5-10 degrees warmer than average for late October.

October 22-23: A cold front swept into the state and set off showers and storms, some of which exceeded severe limits. That cold front also gave the state its first freezing temperatures of the season. Areas in the Panhandle and southeastern Oklahoma dropped below freezing with Kenton coming in with the lowest reading of 24 degrees. A 75 mph wind gust was reported by the Camargo Mesonet site early on the 22nd and half dollar size hail fell near Laverne. Low temperatures dropped close to freezing on the 23rd. Rainfall totals were generally 1-2 inches in northeastern sections but less than an inch elsewhere.

October 24-31: Other than some chilly temperatures each morning, the month's final eight days were quite pleasant right through Halloween. High temperatures were mostly in the 70s throughout this period. The month's coldest reading of 21 degrees occurred at Antlers and Oilton on the 28th.

NOVEMBER DAILY HIGHLIGHTS

November 1-4: November's first four days were unusually warm and mild with highs 10-20 degrees above normal in the 70s and 80s and lows in the 40s and 50s. Virtually no rain fell across the state. Oklahoma City tied a record with a high temperature of 83 degrees on November 2. The month's highest temperature of 86 degrees occurred at Beaver and Slapout on the second.

November 5-6: An approaching storm system dragged a cold front across Oklahoma on the fifth which provided the focus for a rare November severe weather outbreak. Storms formed in central Oklahoma and moved towards the northeast. Severe winds, large hail and heavy rains were common with the thunderstorms. A brief tornado dropped down in Osage County, rolling a mobile home and injuring two occupants. Baseball size hail fell near Piedmont and 70 mph winds were reported near Kaw City and Inola. One-to-two inches of rain fell in the I-44 corridor between Oklahoma City and the northeast corner of the state. More than 4 inches of rain was recorded in Perkins. The cold front made for a cool day on the sixth. Low temperatures that morning fell into the 30s and 40s to go along with winds which gusted to nearly 30 mph. Highs that day rebounded into the 60s and 70s.

November 7-9: Low temperatures were generally in the 30s and highs rose into the 50s and 60s during this three-day period.

November 10-11: A fast-moving storm system brought rain and storms to Oklahoma on the 10th. Showers formed in the morning before dissipating. Stronger storms struck later that afternoon and provided southeastern Oklahoma a good 1-3 inch soaking. Some large hail accompanied these storms. Skies cleared on the 11th and temperatures rose into the 50s and 60s.

November 12-19: This eight-day period generally had very pleasant afternoons which followed chilly mornings. Cold fronts moved through the state on the 14th and the 17th which cooled the state down temporarily, but the afternoons bounced back nicely. High temperatures by the end of the period were in the 70s, 15-20 degrees above normal.

November 20-23: A cold front on the 20th kept high temperatures below the 22nd's marks by about 25 degrees in the 40s and 50s. Winds gusted from the north about 45 mph behind the front. A gradual warm up through the 23rd eventually saw high temperatures back in the 60s and 70s. The month's coolest temperature of 13 degrees occurred at Buffalo on the 21st.

November 24-30: A series of cold fronts kept the weather during this seven-day stretch seasonable with cool, windy mornings and pleasant afternoons for the most part. Fronts moved through on the 24th, 26th and 29th. Light rain fell on the 27th and 28th with a front, and a bit of snow was mixed with rain on the 30th.

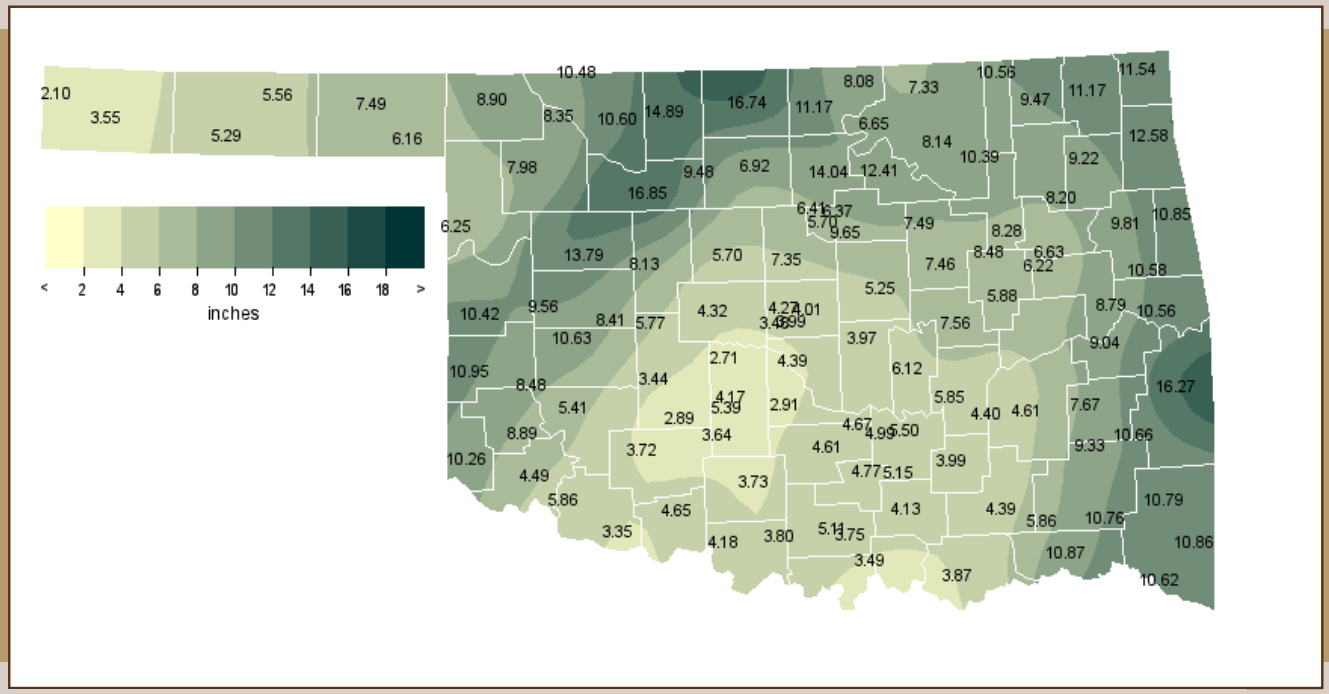
Fall 2008 Statewide Extremes

Description	Extreme	Station	Date
High Temperature	98ºF	Tipton	Sept. 7th
Low Temperature	13ºF	Buffalo	Nov. 21st
High Precipitation	16.85 in.	Fairview	
Low Precipitation	2.10 in.	Kenton	

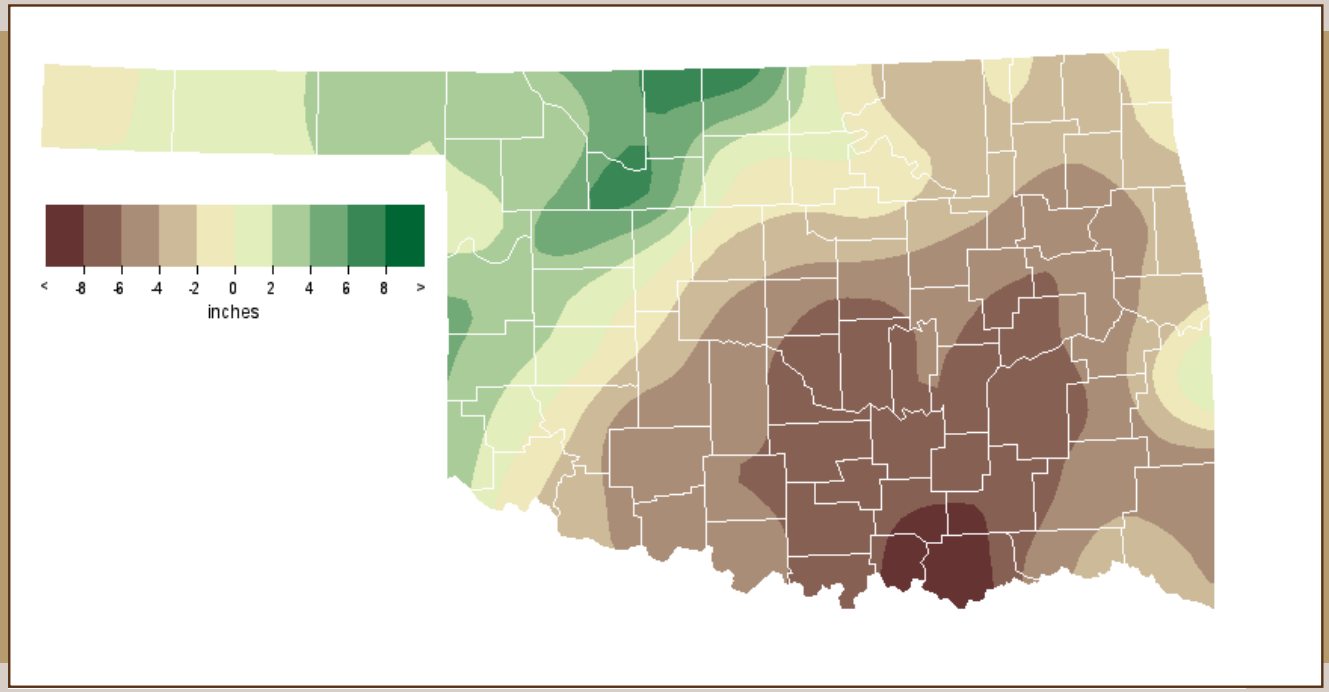
Fall 2008 Statewide Statistics

	Average	Depart	Rank (1895-2008)
Temperature	59.8ºF	-0.8ºF	30th Coolest
	Total	**Depart**	**Rank (1895-2008)**
Precipitation	7.59 in.	-2.42 in.	49th Driest

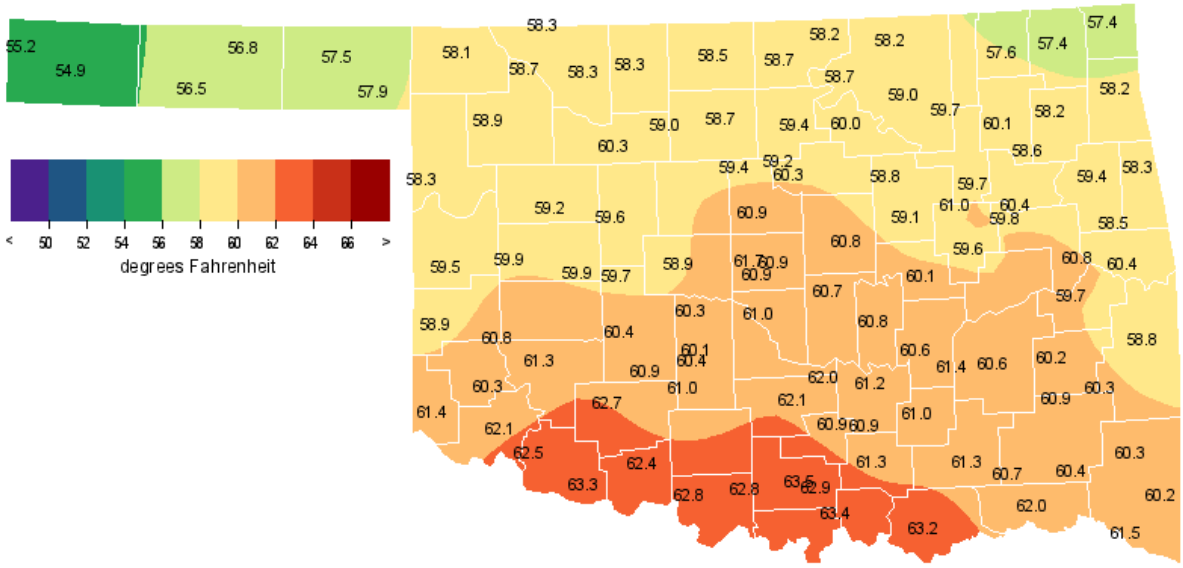
OBSERVED RAINFALL



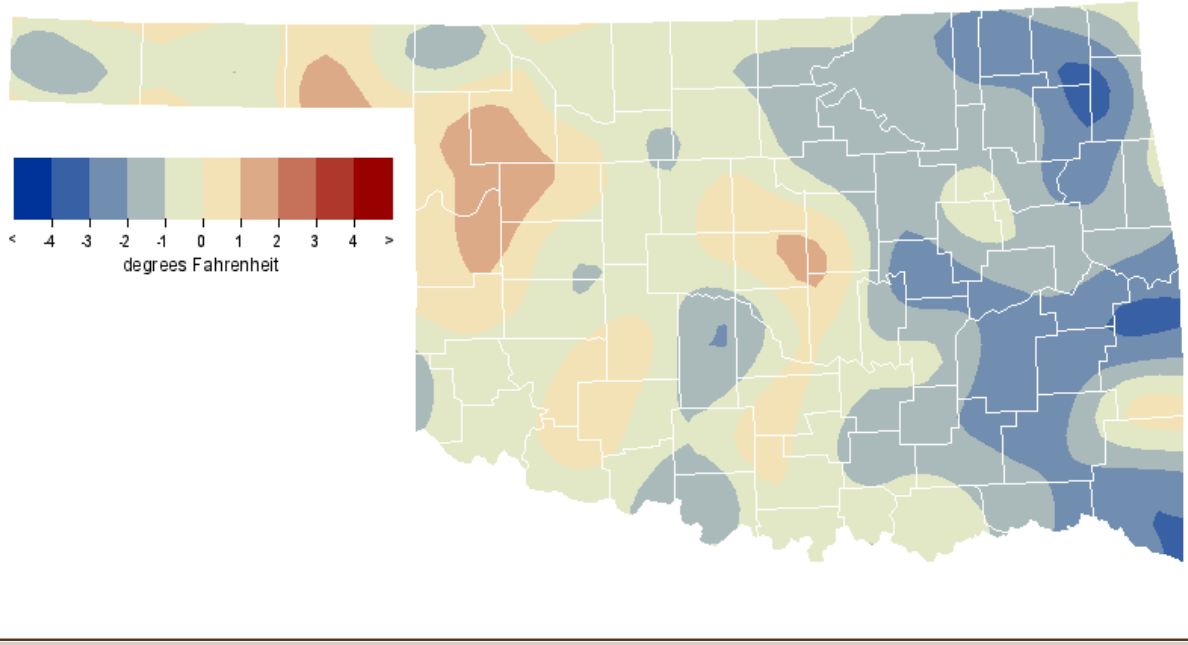
RAINFALL DEPARTURE FROM NORMAL



AVERAGE TEMPERATURE



TEMPERATURE DEPARTURE FROM NORMAL



FALL 2008 MESONET PRECIPITATION COMPARISON

Climate Division	Precipitation (inches)	Departure from Normal (inches)	Rank since 1895	Wettest on Record (Year)	Driest on Record (Year)	2007
Panhandle	5.66	1.23	18th Wettest	10.34 (1941)	0.70 (1956)	1.50
North Central	11.30	3.43	10th Wettest	17.19 (1986)	0.97 (1910)	6.24
Northeast	9.47	-2.56	54th Driest	27.94 (1941)	2.60 (1948)	10.75
West Central	10.05	2.73	13th Wettest	20.71 (1986)	1.01 (1954)	5.38
Central	5.32	-5.26	24th Driest	20.42 (1923)	2.11 (1910)	7.49
East Central	7.92	-5.61	32nd Driest	22.86 (1923)	2.40 (1948)	11.32
Southwest	5.34	-2.76	37th Driest	18.40 (1986)	0.95 (1910)	4.36
South Central	4.38	-7.31	10th Driest	24.03 (1923)	2.18 (1948)	4.70
Southeast	10.37	-4.23	47th Driest	25.15 (1984)	3.11 (1963)	9.75
Statewide	7.59	-2.42	49th Driest	18.15 (1923)	2.44 (1910)	6.82

FALL 2008 MESONET TEMPERATURE COMPARISON

Climate Division	Average Temp (F)	Departure from Normal (F)	Rank since 1895	Hottest on Record (Year)	Coldest on Record (Year)	2007
Panhandle	56.9	-0.2	45th Coolest	62.7 (1963)	53.6 (1976)	59.7
North Central	58.8	-0.8	33rd Coolest	65.8 (1931)	56.0 (1976)	61.2
Northeast	58.8	-1.3	26th Coolest	66.6 (1931)	55.3 (1976)	62.2
West Central	59.7	0.0	50th Coolest	65.7 (1931)	55.9 (1976)	62.0
Central	60.3	-0.9	32nd Coolest	67.3 (1931)	56.9 (1976)	63.2
East Central	60.0	-1.5	21st Coolest	67.6 (1931)	56.7 (1976)	64.3
Southwest	61.6	-0.3	47th Coolest	66.9 (1931)	57.1 (1976)	64.2
South Central	62.1	-0.8	31st Coolest	68.3 (1931)	57.8 (1976)	64.9
Southeast	60.5	-1.5	12th Coolest	68.3 (1931)	56.8 (1976)	62.9
Statewide	59.8	-0.8	30th Coolest	66.3 (1931)	56.2 (1976)	62.7

FALL 2008 MESONET EXTREMES

Climate Division	High Temp	Day	Station	Low Temp	Day	Station	High Monthly Rainfall	Station	High Daily Rainfall	Day	Station
Panhandle	92	Sep 1st	Buffalo	13	Nov 21st	Buffalo	8.90	Buffalo	2.71	Oct 14th	Buffalo
North Central	94	Sep 1st	Fairview	14	Nov 21st	Woodward	16.85	Fairview	9.13	Sep 12th	Fairview
Northeast	92	Sep 1st	Burbank	16	Nov 21st	Miami	12.58	Jay	3.29	Sep 13th	Vinita
West Central	92	Sep 7th	Weatherford	16	Nov 21st	Camargo	13.79	Putnam	6.71	Sep 11th	Putnam
Central	94	Sep 2nd	Marshall	15	Nov 21st	Oilton	9.65	Perkins	4.04	Nov 5th	Perkins
East Central	93	Sep 12th	Webbers Falls	18	Nov 21st	Westville	10.85	Westville	3.51	Sep 3rd	Cookson
Southwest	98	Sep 7th	Tipton	16	Nov 21st	Mangum	10.26	Hollis	4.01	Sep 11th	Hollis
South Central	94	Sep 7th	Newport	21	Nov 21st	Centrahoma	5.50	Ada	2.47	Sep 13th	Ada
Southeast	93	Sep 1st	Antlers	20	Nov 22nd	Wister	16.27	Wister	3.31	Sep 9th	Wister
Statewide	98	Sep 7th	Tipton	13	Nov 21st	Buffalo	16.85	Fairview	9.13	Sep 12th	Fairview

AgWatch

by Albert Sutherland, CPA, CCA
Mesonet Assistant Extension Specialist
Oklahoma State University

Over the winter of 2008-2009 we saw a mild La Nina form in the Pacific. As commonly occurs with a La Nina, Oklahoma has experienced a warmer, dryer winter and is likely to see a continuation of this trend as spring develops in 2009.

All of Oklahoma has seen less rainfall than normal for the period of December 3, 2008, to March 2, 2009 (Figure 1). The significance of this dryer winter is emphasized in Table 1. Six of the nine Oklahoma climate regions have dropped into the driest ten percent of years from 1921. For the West Central Oklahoma climate region, this has been the 2nd driest winter in the last 89 years.

With the dryer winter, especially in western Oklahoma, 42% of the wheat crop was rated as poor or very poor, while only 23% was rated as good or excellent in the March 2, 2009, Oklahoma Crop Weather report. In this same report, 40% of pasture and range was rated as poor or very poor, while a mere 20% was rated as good or excellent.

While this has been a dry winter, some areas have been blessed with heavier bands of rain or sleet that fell in January 2009. Driving on sleet-covered roads can be a real hazard, yet for agriculture it is an excellent form of winter precipitation. Sleet packs a lot of water content, especially compared to snow. As sleet melts it acts like a drip irrigation system. The water is slowly released, allowing the soil to soak up every drop. This can really pump up soil moisture.

The soil moisture map in Figure 2 shows how the January 2009 sleet added a good amount of water to some areas of Oklahoma. Mesonet site locations with Fractional Water Index values of 0.70 or above are sites with good soil moisture. These locations are the darker green areas on the map of 10-inch soil moisture in Figure 2. This map shows how the eastern soils are wetter than those in the western Oklahoma, designated by the yellow and light green areas.

As we look deeper in the soil, the soil moisture map in Figure 3 shows those areas that are dry at 24 inches. Note the brown and tan areas with Fractional Water Index values in the teens or lower. These are areas of very dry, deeper soil. Going into the spring and summer with deep dry soil is like writing checks without money in the bank. When crop water demand increases, this deeper moisture is needed to keep plants going between rain events. If there is enough rainfall to meet crop demand, then all is well. The problem develops when the rains are too light or too far apart to meet the water needs of the crop. So starting off the season with no deep soil moisture is a real concern for farmers and ranchers in these dryer soil areas.

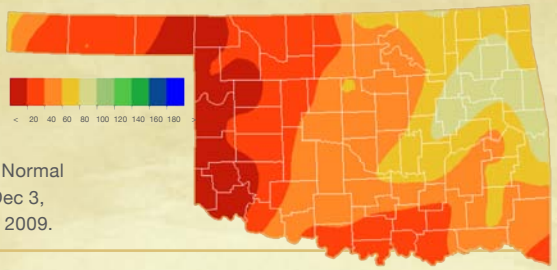


Figure 1: Percentage of Normal Rainfall from Dec 3, 2008 to Mar 2, 2009.

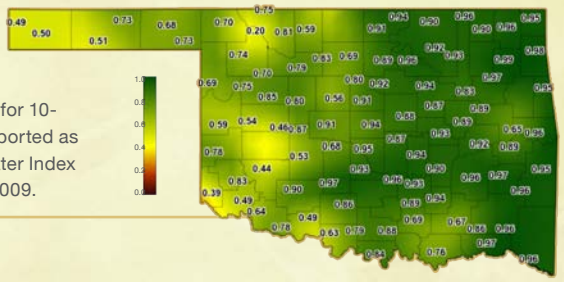


Figure 2: Soil moisture for 10-inch depth reported as Fractional Water Index as of Mar 2, 2009.

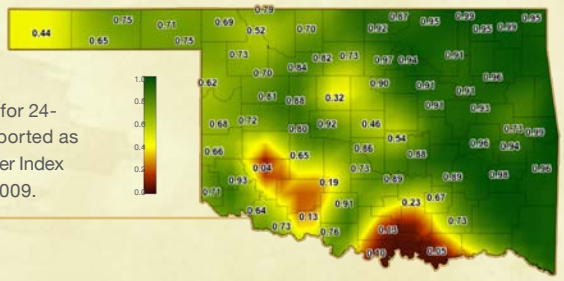


Figure 3: Soil moisture for 24-inch depth reported as Fractional Water Index as of Mar 2, 2009.

Table 1:
Rainfall by Oklahoma Climate Region from Dec 3, 2008 to Mar 2, 2009.

Climate Division	Total Rainfall	Departure from Normal	Pct of Normal	Driest since	Wettest since	Rank since 1921 (88 periods)
Panhandle	0.41”	-1.51”	22%	2005-06 (0.39”)	2007-08 (3.13”)	4th driest
N. Central	1.30”	-2.24”	37%	2005-06 (0.56”)	2007-08 (5.42”)	8th driest
Northeast	4.55”	-1.37”	77%	2005-06 (1.65”)	2007-08 (8.29”)	34th driest
W. Central	0.69”	-2.55”	21%	2005-06 (0.58”)	2007-08 (4.59”)	2nd driest
Central	2.82”	-2.50”	53%	2005-06 (0.95”)	2007-08 (6.12”)	16th driest
E. Central	5.67”	-1.94”	74%	2005-06 (2.29”)	2007-08 (7.13”)	30th driest
Southwest	1.21”	-2.62”	32%	2005-06 (0.38”)	2007-08 (3.98”)	6th driest
S. Central	2.88”	-3.83”	43%	2005-06 (2.42”)	2007-08 (4.72”)	6th driest
Southeast	5.54”	-4.50”	55%	2005-06 (4.92”)	2007-08 (9.54”)	7th driest
Statewide	2.78”	-2.52”	52%	2005-06 (1.52”)	2007-08 (5.86”)	8th driest

To access the products mentioned in AgWatch go to Oklahoma AgWeather at **http://agweather.mesonet.org**. Data on the Oklahoma Agweather Web site is from the Oklahoma Mesonet, managed in partnership by the University of Oklahoma and Oklahoma State University and operated by the Oklahoma Climatological Survey.

Urban Farmer

by Albert Sutherland, CPA, CCA
Mesonet Assistant Extension Specialist
Oklahoma State University

February

- Test lawn and garden soils. Contact your local County OSU Extension office for soil testing bags, pricing, and sampling information.
- Prune fruit trees.
- Spray peach trees with lime-sulfur soon after pruning and before bud swell to control peach leaf curl.
- Fertilize pecan and fruit trees based on a soil test. Without a soil test, the general recommendation is to apply one tenth of a pound of actual nitrogen per year of tree age per tree, up to a maximum of 3 pounds of actual nitrogen per tree for pecan, 1 pound of actual nitrogen per tree for apple and plum, and 0.5 pound of actual nitrogen per tree for peach, pear, and cherry.
- Fertilize ornamental trees and shrubs. Use a quick release fertilizer at a rate of 1 pound of actual nitrogen per 1,000 square feet of root area. Tree and shrub roots extend out 2-3 times the distance from the trunk to the branch ends (tree dripline). Apply before a rain or water in.
- Trim over-wintering stems and grass blades from ornamental grasses.
- Fertilize fescue after mid-February. Use a quick release fertilizer at a rate of 0.5 to 1 pound of actual nitrogen per 1,000 square feet.
- Plant seeds for tomatoes and peppers for transplanting in early April and for flowers, such as wax begonia, seed geraniums, impatiens, lobelia, salvia, verbena, and vinca, to be transplanted in late April.
- Shear evergreen shrubs and prune summer-flowering shrubs. Do NOT prune spring-flowering shrubs in February. Prune spring-flowering, just after they bloom.
- In late February, apply a pre-emergent herbicide for crabgrass control. Water in if less than ½ inch of rain falls within a week to 10 days of application.

March

- March is an excellent month to plant trees and deciduous shrubs. This can help you tame the “planting bug.” You’ll have something to plant that can handle late March freezes.
- Fill in shady lawn areas by over-seeding with a blend of tall fescue and Kentucky bluegrass.
- Divide and replant summer-flowering perennials.
- Trim liriope, commonly referred to as monkey grass, in early March by hand clipping or with a mower on its highest cut setting.
- Control weeds in flower beds.
- Spread compost or aged manure.
- Plant frost tolerant vegetables, such as beet, broccoli, cabbage, carrot, Swiss chard, kohlrabi, lettuce, onion, green peas, potato, radish, spinach, and turnip.
- Make plans for perennial and annual flowerbeds.

April

- After mid-April, there is little danger of frost for most of Oklahoma. This is an excellent time to make a trip to your favorite nursery for annual and perennial plants.
- April is the month for planting evergreen shrubs. Planting evergreens in April avoids March freezes that can damage young, tender foliage.
- Apply a labeled fungicide to pine trees to control the devastating disease, Diplodia Tip Blight. Make the first application when pine tip candles have expanded to half their full size. When the disease is severe, make three applications at 10-14 day intervals.
- In the garden, set out tomato, pepper, and eggplant transplants. Plant sweet corn during the last week of March or in early April. Lima bean, green bean, cucumber, and squash do better once warmer temperatures arrive, typically after April 10.
- In the later part of April, fertilize bermudagrass turf areas with one pound of actual nitrogen per 1,000 square feet of lawn area. For zoysiagrass, cut this rate in half.

Nicole Giuliano

How Snow Grows

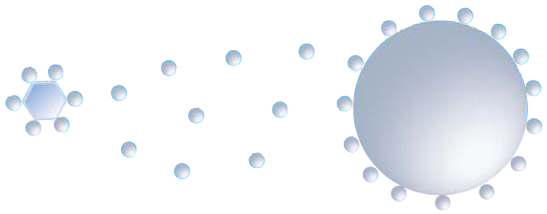
In the winter, as the days grow shorter and cold winds blow, children across the nation hope for snow—preferably enough to cancel school for a day or two. But how does snow grow enough to create a snow day?

There are several processes that a tiny ice crystal in a cloud can experience: the Bergeron process, aggregation, and accretion. Depending on the processes involved, the result can be snowflakes, graupel (small, round pellets of snow or ice), or something in between. As shown in Figure 1, the Bergeron process involves a small ice crystal and a liquid droplet that is supercooled (the temperature is below freezing, but the droplet remains in liquid form). There are more water vapor molecules (the gas state of water) surrounding the liquid droplets than there are around the ice crystals (Figure 1a). Since the atmosphere tries to even out the number of molecules, the water vapor moves toward the ice crystal. This gas immediately freezes on the ice crystal (deposition—the change in state from gas to solid), which makes the crystal grow (Figure 1b). The droplet slowly evaporates to replace the water vapor molecules that it has lost, which continue to move toward the ice crystal (Figure 1c). The fastest ice crystal growth during this process typically occurs around 5ºF (-15ºC).

After an ice crystal has grown through the Bergeron process, it may become heavy enough to fall and then continue to grow through accretion and aggregation. Accretion (or riming) is a process in which ice crystals collide with supercooled droplets that freeze on contact with the crystals, as seen in Figure 2. Graupel (or snow pellets) can often result from growth by accretion.

Figure 1 - The Bergeron Process

1a: More water vapor molecules are around the relatively large liquid droplet than are around the small ice crystal.



1b: Water vapor moves toward the ice crystal, freezing immediately and adding to the crystal's size.

1c: The liquid droplet evaporates to replace the water vapor around it, shrinking as the ice crystal continues to grow.

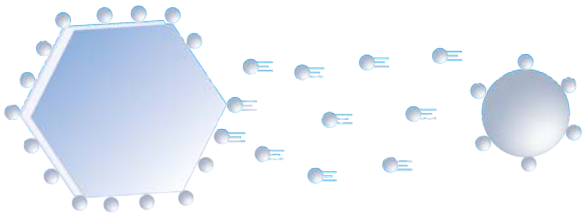
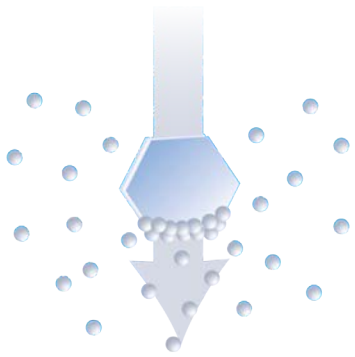


Figure 2 - Accretion

2a: An ice crystal collides with supercooled droplets as it falls.



2b: Supercooled droplets freeze on contact, creating graupel.

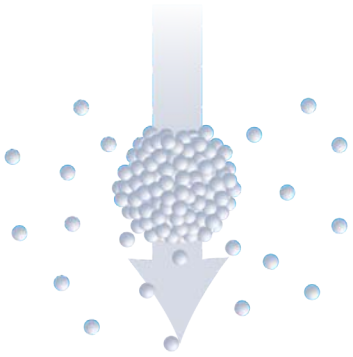
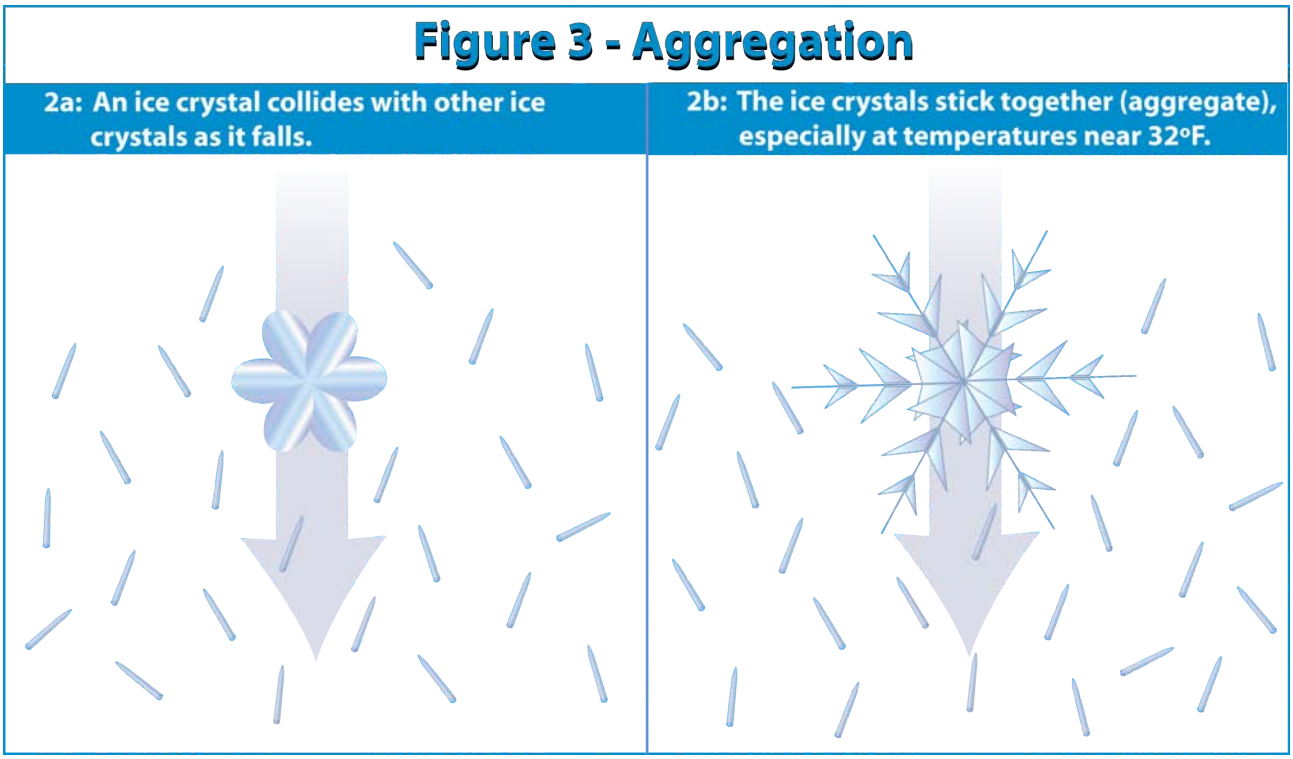


Figure 3 - Aggregation



The ice crystals grow by these collisions with supercooled droplets and continue to fall, sometimes colliding with one another and breaking into many tiny ice particles. These ice particles create even more ice crystals (ice splintering), which may collide and stick together—a process called aggregation (Figure 3). The ice crystals stick more to one another (aggregate) in areas with slightly warmer temperatures (near freezing), since liquid water can act as a bond between crystals. Snowflakes are generally created by growth by aggregation. In fact, the stickier the ice crystals, the bigger the snowflake that can potentially form. The maximum aggregation occurs around 32°F (0°C), the melting point.

These processes in the cloud can result in very complex ice structures, as an ice crystal may experience any combination of aggregation and accretion. For example, one ice crystal might grow by aggregation and then pass through an area of supercooled droplets, where accretion occurs. As it continues to fall, the ice crystal might once more bump into other ice crystals, continuing to grow by aggregation. Figure 4 shows a few of the more common ice habits (shapes of ice crystals), as well as the temperatures at which many of the types form. Every ice crystal is unique—no two go through the exact same process for the same amount of time, in the exact same area. So, the saying "No two snowflakes are alike" is true indeed.

Figure 4 - Ice Crystal Habits By Temperature

Temperature (°F)	Crystal Habit	Shape
25 to 32	Thin plates	
21 to 25	Needles	
14 to 21	Columns	
10 to 14	Plates	
3 to 10	Dendrites, Plates	
-8 to 3	Plates	
-40 to -8	Hollow Columns	

CLASSROOM ACTIVITY

Nicole Giuliano

Questions

Part I

Use the previous article to answer the following questions:

1. Why are the largest snowflakes usually seen when the temperature is just below freezing (colder than 32ºF)?

2. Which ice crystal habit(s) would you expect to find in the following clouds:

a. A cloud that has a temperature of 23ºF?
b. A cloud with a temperature of 8ºF?
c. A cloud that has a temperature of -8ºF?

3. Bonus: Which process (Bergeron, accretion, or aggregation) most likely produces hail? (HINT: Hail is made of layers of ice, much like a jawbreaker candy)

Part II

Using the following websites, answer the next three questions
(HINT: You may need to explore the sites to find the answers):

http://snowcrystals.com
http://snowflakebentley.com
www.popularfront.com/snowdays

1. (a) How many sides does a snowflake have?
(b) Do triangular snowflakes exist?
(c) Is it ever too cold to snow?

2. Who was “Snowflake” Bentley?

3. Create your own snowflake at www.popularfront.com/snowdays by clicking on “Create Your Own Snowflake” in the central bottom part of the site. “Clip” parts out of the virtual paper by drawing lines with the left button of the mouse. As you make cuts, the program shows the result of each cut. How does each slice affect the final snowflake? Write your observations here.

Answers

Part I

1. The largest snowflakes are usually found near freezing because the greatest amount of aggregation occurs near 32ºF. The snowflakes are at their "stickiest" near this temperature, so it is easier for flakes to clump together and make large snowflakes.

2.
a. Needles
b. Mix of Dendrites and Plates
c. Mix of Plates and Hollow Columns

3. Accretion is the main process by which hail grows. The hailstone is lifted into the air by a strong updraft in a thunderstorm, accumulating supercooled droplets that freeze onto its surface. The hailstone stays in the air due to the updraft, until the hailstone has grown so much that the updraft can no longer keep it from falling.

Part II

1. (a) 6 sides, (b) Yes, but they are rare, (c) No, technically it can snow as long as the temperature is below freezing. Snow becomes rarer at temperatures below about -4ºF in areas that tend to be warmer than the South Pole.

2. A farmer who was the first person to photograph a single ice crystal. He came to the conclusion that no two snowflakes were alike after photographing more than 5000 snowflakes, none of which were identical.

3. Answer varies. Example: When I cut the bottom of the triangle, it changes the appearance of the outside of the snowflake.

REFLECTIONS OF A MESONET TECHNICIAN:

THE ROAD LESS TRAVELED

BY KEN MEYERS SENIOR ELECTRONICS TECHNICIAN

In the movie Blade Runner, the replicant soldier, played by Rutger Hauer, in his final moments says,

"I've seen things you people wouldn't believe. Attack ships on fire off the shoulder of Orion. I've watched sea beams glitter in the darkness ten hours a day. All those moments will be lost in time like tears in rain."

I've also seen things you people wouldn't believe, mostly driving by at 65 mph. You could reduce my day to the following,

Drive 3 hours- Work 10 minutes

Drive 2 hours- Work 30 minutes

Drive 2 hours- Work 20 minutes

Drive 2 hours home.

But the detail in this day makes this time far more interesting, many times fascinating. On daily trips to my sites, I have become a student of nature, culture, and history. Over the years, watching the seasons change, small towns grow while others die, and small country roads turn into crowded four lane highways has turned the windshield in my truck to a panoramic story.

I describe Norman as being an island that in no way represents what happens out in, what I refer to as, the 'real world'. Living in Norman you can get a false sense of the diversity of Oklahoma. I will try to give you a hint of this 'real world' by describing a typical day.

I leave my house in Ardmore headed to Grandfield. Early in the morning I have a good chance of seeing deer, turkey, and the herd of llamas near the big lake covered with ducks and Canadian geese. At the Grandfield site I may find a family of mice living in the cables going into the enclosure box. I carry them outside the fence, their one chance for freedom. After cleaning out the nest, I put a packet of poison in the wires – no second chance! I also make sure that the grass around the tower is short so that the owl that perches on the lightning rod at night and deposits her pellets full of bones has a better chance to ensure that no more wires are chewed when the mice try to restore their nesting area.

On the way out of Grandfield, I like to see what stage the cotton or wheat is in, depending on the season, and what new project is taking place at the Grandfield airport that I drive through to get to the site. I then head for the Altus area. I detour at Hackberry Flats to see what migratory birds are presently in Oklahoma. I drive on dirt roads through flooded fields and see thousands of ducks, geese, and shore birds on my way to Tipton. I try to remember any new bird that I see so that I can look it up when I get home.

The Tipton and Altus sites are located at OSU Agriculture Experiment Stations. In that part of the State, cotton is king and these Ag stati ons reflect this by growing the best cotton in the area. On the trip between Tipton and Altus, I get to see the big military transport planes lumbering overhead on their training flights. I used to dislike the Altus site because of all the goatheads. The bottom of my shoes and the floor of my work truck would always be covered with them. I realized one day that the function of the spikes on the seeds is to allow them to stick to the hooves of ancient buffalo herds and be transported and planted in a new and maybe better location. Realizing that I have replaced the ancient buffalo has given me an appreciation for the plant. After I leave the Altus site, I drive through Altus on my way to Mangum.

next >>

Altus, a military town, brings back memories of my four years in the service. You can tell that this is no ordinary Oklahoma town because it has more bars than churches and the average age appears to be below forty. Also, it is one of the few towns in Southwest Oklahoma that doesn't have half the stores on Main Street boarded up. This is usually the time of day that I eat my lunch. Because I always eat lunch while I am driving, what I eat is determined by whether or not it will explode when I bite into it. Over the years I have trashed many a shirt during lunch.

The Quartz Mountains grow larger on my trip from Altus to Mangum. The years have reduced them from mighty mountains to pink granite hills. This is wild rattlesnake country that had all the resources to keep the early Plains Indians alive and thriving. Today it takes a caravan of trucks and Federal military dollars to support the present level of civilization in this area.

Arriving at Mangum, I must walk through a deep ravine from the road to the site. This is to make sure that it is dry enough to cross by truck. Upon arrival, I pull the tumbleweeds off the fence and take them out of the site to send them on their merry way. The Mangum site is almost pure sand which allows sunflowers to thrive and not much else. After I complete what I need to do at the Mangum site, I look to see where the sun is in the sky to let me know if I have time for 'one more' site. I determine that this is enough for one day and start the long trek home. I tune my satellite radio to the 'Chill' station and watch the sun set in my rear view mirror while planning what I will do tomorrow.

As you can tell, so much happens on just one day in the field. Realize that there are three more days of field work during the week. Each day is as different and as interesting as the last.

Each day and each site has its own amazing story. I am feeding a red ant colony at Byars to see how big I can get it. When my area was the Northeast part of the State, I fed a colony at Redrock for ten years. I collect lady trusses orchids at Tishomingo and Pauls Valley for the Noble Foundation. They are studying the fungus on the roots to possibly be used in their switchgrass research. At Madill there is a battle between the fireants and the gophers. If I kill the fireants, the gophers return to the site and chew on the underground cables. If I leave the fireants, I get stung when I cut the grass. The site at Acme has swans living on the nearby lake in the winter. The ARS and FORCARS Micronets have been sagas of change since I first installed them. Each site and area has its own unique history.

When we hire a new technician, I tell them that they need to find something interesting to do on the road. I explain that if they don't have something to look forward to each day, after a

while, they will just be driving around in circles. Photography, site seeing, Oklahoma history, and nature watching are some of the recommendations I suggest for them to try out. In the same breath, I warn them not to get into 'road food'. Knowing what town has the best barbecue will only expand the waistline. I have chosen fishing as my dessert and the end of the day. Occasionally, I plan my day to stop at a local fishin' hole to fly fish for an hour or two. One of my hobbies is designing fishing flies. I like to ponder what I learn from these stops to develop new flies that work for different situations and locations. I met two ARM technicians years ago at the Foraker site. One of their sites is just north of our Mesonet site. They were trying to play 9 holes on every local golf course in Northern Oklahoma and Southern Kansas along their route. They found a novel way to keep from driving around in circles.

"EACH DAY AND EACH SITE HAS ITS OWN AMAZING STORY."

As you can guess, I find it hard to leave an occupation that I have enjoyed so much. But, I am getting older and it seems that the summers are hotter and the Winters colder. I am looking forward to what the next twenty plus years brings. I hope that they are as interesting as the last. If I was asked, "What are the most important things that I learned over the years?" I would reply, without hesitation, "Coppertone makes the best sunscreen, McDonalds has the best coffee, and county courthouses have the cleanest restrooms!" I guess the question that should have been asked is, "What is the most important thing that you have gained over years?" I would say that, "Being part of something that is as 'important' as the Oklahoma Mesonet is a privilege and not a job." Knowing that you contribute to something that saves lives, helps farmers grow their crops, and everyone, like me, plan their week makes me realize that I have gained more than my share of 'life points'. It will be very sad to leave the project and I hope that all my moments with the Oklahoma Mesonet won't be lost like tears in rain-gauges.

FALLING FOR A SLICK TRIP:
HOW NOT TO BREAK YOUR BUM

By Phil Browder, Field Technician

We've all done it—you're on your way to the car, or walking up the steps to work, or just peeking out your front door to greet the morning chill of a winter day….and WHOOPS! There goes your feet over your head thanks to the ice right under your nose you may, or may not, have noticed. In the second or so you have to think before your elbow or shoulder or bum hits the ground, there's only one thing that comes to mind: "This is going to hurt".

The National Safety Council estimates that occupational falls cause more than 300,000 injuries per year, along with approximately 1,500 deaths. In fact, injuries sustained from falls are the leading cause of death among Americans over the age of 65. In order to help prevent those unfortunate wintertime quick trips to the pavement, here are a few tips that can keep you upright.

Wear proper foot gear for good traction

- Think rubber and neoprene composite soles, not plastic or leather.
- Try buying a pair of "ice buddies" that strap onto your shoes and act as little snowshoes.

Watch your comings and goings

- Entrances and exits are prime locations for slick ice.
- Nearly half of all falls occur on stairs, so always use the handrail. If there isn't one, you're proceeding at your own risk.
- Step, don't jump, into and out of vehicles.

Walk softly, and avoid carrying any big sticks

- Take small steps or shuffle to keep your center of gravity under you.
- Walk slowly with bent knees, keeping your feet pointed slightly outward (Yeah, you will look a little silly…but imagine how silly you will look sprawled out across that ice rink of a parking lot).
- Keep your hands free, not in you pockets, for better balance.

Despite your best efforts, you're bound to slip and slide sooner or later. If you find yourself on the way down, you can reduce your chance of injury with the following tips.

Roll, not rock

- Roll with the fall. Try to twist and roll backwards, rather than falling forwards.

Think of a happy place

- I know it sounds far fetched, but try to relax your body as much as possible on the way down. This way, you're totally at peace when you slam into the ground.

Toss your cookies

- Or anything else you're carrying. Protect yourself instead of the objects being carried.

Assume the position

- Avoid using your arms to break your fall, or they might get broken themselves.
- Try landing on multiple body parts in order from the ground up. For instance, let your thigh hit the ground first, followed by your hip, and then your shoulder. This will divide the impact force among the three, and not concentrate it on just one area, like your hip.
- If you fall backward, make a conscious effort to tuck your chin so your head doesn't strike the ground with full force, which could lead to a concussion or worse.

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